REMARKS

Claims 1-10, 12-30, 33-39, 42, and 49-56 will be pending upon entry of the present amendment. Claims 1, 4, 7, 9, 12, 13, 18-20, 29, and 38 are amended, claims 31, 32, 40, 41, and 43-48 are canceled, and new claims 49-56 are newly submitted herewith.

Applicants thank the Examiner for indicating the allowability of the subject mater of claims 18-24. Accordingly, claim 18 has been placed in independent form.

Support for subject matter added in the present amendment to claims 1, 4, and 29, and for the subject matter of new claims 50, 53, and 55, can be found in the specification of the present application (hereafter *specification*) at page 13, line 12 and page 21, line 26 to page 22, line 9.

The Examiner has restricted claims 44-48 as being drawn to a non-elected species. Accordingly, claims 44-48 are cancelled without prejudice, waiver, or disclaimer to pursuing the subject matter of such claims via one or more continuing applications.

Rejections Under 35 U.S.C. § 112, First Paragraph

Claims 40 and 43 were rejected under 35 U.S.C. § 112, first paragraph, as being indefinite for failing to point out and distinctly claim the subject matter which is regarded as the invention. Both claims recite "selectively varying a retracting bias," for which the Office Action indicates there is insufficient support in the specification. While Applicants believe that one of ordinary skill in the art would find adequate support for the rejected claims in the specification as originally filed, claims 40 and 43 are cancelled to reduce the number issues for consideration, and to move the application toward issuance.

Claim 13 was rejected under 35 U.S.C. § 112, second paragraph, as being indefinite for failing to point out and distinctly claim the subject matter which the applicant regards as his invention. Claim 13 recites "the sensor array, for which the Office Action indicated there was insufficient antecedent basis. Claim 13 has been amended to depend from claim 12, which, as currently presented, provides the necessary antecedence.

Summary of Rejections Under 35 U.S.C. §§ 102 and 103

Claims 1, 3-7, 9, 10, 12, 14, 29-33, 40, and 43 are rejected under 35 U.S.C. §102(b) as being anticipated by Sato et al. (U.S. Patent 5,305,429, hereafter *Sato*); claims 1, 12, 14, 16, 17, and 26-28 are rejected under 35 U.S.C. §102(b) as being anticipated by Kim et al., ("Design of Tension Based Haptic Interface: SPIDAR G" (hereafter *Kim*); claims 2, 15, and 34-37 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kim in view of Lefkowitz et al. (U.S. Patent 5,440,476, hereafter Lefkowitz); claims 8, 38, 39, and 41 are rejected under 35 U.S.C. §103(a) as being unpatentable over Kim; and claim 32 is rejected under 35 U.S.C. §103(a) as being unpatentable over Sato.

In the responses that follow, when citing to a specific passage of a U.S. patent, a column number will be separated from a line number by a colon, e.g., 4:22, indicating column 4, line 22. Page and line numbers of the specification will be cited to in a similar fashion.

Prior to addressing the specific rejections, applicant wishes to discuss the Sato reference as it relates to embodiments disclosed in the specification. Sato's Figure 3 is reproduced herebelow:

FIG.3

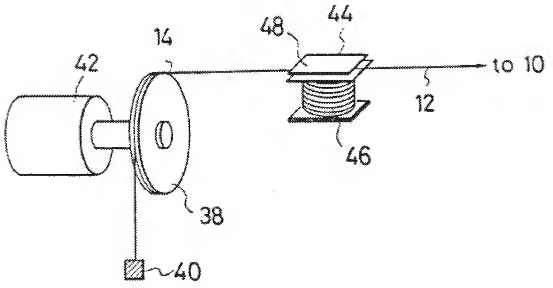

Figure 3 shows a representative one of Sato's four lines 12-1 to 12-4 with position measuring and drag generating means (*Sato,* 2:58-61). The four lines 12-1 to 12-4 collectively support the instruction point 10 (3:29, 30). The instruction point is attached to the finger tip of an operator (3:37, 38) for "variable length" operation, in which the lengths of each of the lines, between the respective fulcrum point 14 and the instruction point 10, is varied according to the position of the operator's finger in three dimensions (3:29-34). Sato's system provides an equal weight 40 on each of its lines, such that, if the operator releases the instruction point 10 at any location in the three-dimensional space, the point will remain motionless at that location (3:38-45 and (4:3-5). In order to simulate an obstruction, Sato applies drag to one or more of the lines, hindering or preventing movement of the instruction point (6:30-36). This is accomplished via the relays 44, which apply a gripping force to their respective lines (6:65-7:13). This introduction of drag does not vary the tension on the lines. In other words, the tension on Sato's lines remains always neutral, inasmuch as the four lines remain balanced such that the operator never experiences a pull in one direction or another, but only passive resistance to movement of the instruction point by the operator. Sato's system cannot, for example, move the instruction point independent of the operator. Because the weights are balanced, as noted above, the lines will remain motionless unless acted upon by the operator, regardless of whether or not the relays grip some or all of the respective lines.

In contrast, the system according to disclosed embodiments provides for a selectively variable tension that can be controlled to exert more or less pull to any of the associated cables, meaning that tension is not necessarily always balanced (*specification*, 14:14-18). Thus, the system can render true reaction forces such that an operator will experience a counter force rather than just an increased drag (18:10-14 and 19:26-20:2). One of ordinary skill in the art will recognize, in particular in view of the description at 27:28-28:22, that the system is capable of rendering an unbalanced tension so as to physically move the attachment point independent of the user, which, as explained above, Sato cannot do because the tension on its lines cannot be varied.

Response to Rejections Under 35 U.S.C. § 102

Claim 1 recites, in part, "a brake configured to lock the first tool translation effecter device when electric current is removed therefrom." Sato fails to anticipate this limitation. In contrast to the claimed invention, Sato's device exerts a drag when current is applied, and releases its cables when the current is removed (*Sato*, 6:65-7:2). Nor is such a distinction a mere design choice. In Sato's system, the drag generating means is normally open, restricting passage of its line only when the instruction point encounters an obstruction (3:40-43, 3:65-4:4, and 6:30-47). In Sato's system as disclosed, the duty cycle of the solenoid 42 will be low, which will affect the cost and power capacity requirements of the solenoid and all the associated control circuitry. If the arrangement were reversed so that Sato's solenoid remained under power except when drag was required, the duty cycle would be generally much higher, requiring more robust and thus more expensive components and circuitry. It is therefore more efficient and economical to apply power to the solenoids 42 only when activation is required rather than vice-versa, and, in the absence of some explicit motivation to the contrary, one of ordinary skill in the art would not consider the opposite arrangement a mere design consideration. Accordingly, claim 1 is allowable over Sato.

For its part, Kim is entirely silent with regard to a brake configured to lock a tool translation effecter device. Accordingly, claim 1 is also allowable over Kim.

Claim 3 recites "establishing means [for establishing a distance between the first tool translation effecter device and the attachment point, which] includes a controller configured to direct the first tool translation effecter device to retract, during an initialization procedure, the first cable until the attachment point is at a selected position relative to the first tool translation effecter device." Sato fails to anticipate this limitation of claim 3. The Office Action points to Sato, at 4:49, 50 as anticipating claim 3. The cited passage states that, "[i]n FIG. 4, assuming that the coordinate position of the instruction point 10 is set to P(x, y, z), the coordinate positions of the fulcrums 14-1 to 14-4 are …," and proceeds to provide the values that are set into its processor. There is no suggestion that Sato's system is capable of moving the instruction point to that location, or even that the described process is for initialization. Instead, in the paragraph just prior to the cited passage, Sato indicates that the process described is for the purpose of

calculating the position of the instruction point in space (4:46-48). In the paragraphs that follow the cited text, it is clear that the process described assumes known line lengths and is for ongoing tracking of the instruction point. The Sato reference does not specifically address initialization, merely stating that "by giving an initial value of the length from the fulcrum 14 of the line 12 to the instruction point 10 and, further, by accumulating and adding the amounts of change, the length from the fulcrum 14 of the line 12 to the instruction point 10 can be measured in a real time manner." (4:21-26.) Finally, Sato is not capable of independently moving its instruction point, and has no element with the ability to retract any of the lines, and so cannot anticipate claim 3, which is therefore allowable thereover.

Based upon Applicants' review of the Sato reference, it appears that, with the exception of the short passage cited above (4:21-26), Sato is entirely silent regarding initialization, and so cannot anticipate any of claims 3-6, 17, 29, 30, or 33. The passages cited in rejecting claims 6 (7:14-33) and 29 (equation (1) on page 4) are inapposite, referring to ongoing tracking operations and components, and inherently assume that the system has been previously initialized, inasmuch as known values are employed to determine new values.

Claim 7 recites, in part, "a sensor array at the attachment point configured to provide signals corresponding to an orientation of the attachment point." Sato fails to anticipate this limitation of claim 7. The Office Action points to Sato's four encoders 42 as being "configured to provide signals corresponding to an orientation of the attachment point." The term *orientation*, as used in the specification, is used exclusively to refer to attitude, i.e., one or more of roll, pitch, and yaw (see, for example, specification, at 16:2, 19:14 and 18, and 22:28). In contrast, the term *position* is generally used to refer to the location in space of the attachment point, in particular when used in conjunction with *orientation*, as at 19:20 19:25, 22:10, and 23:6. Data from Sato's four encoders 42 is used to determine the position of Sato's instruction point in space, but cannot also provide information regarding orientation. Furthermore, Sato's encoders are not *at* the attachment point, as recited in claim 7, but instead are located remotely, at widely separated locations. Thus, Sato fails to anticipate claim 7.

With regard to claim 8, which depends from claim 7, Kim also fails to provide a sensor array *at* the attachment point, and cannot therefore teach or suggest the limitations of claim 8 for at least that reason.

Claim 9 has been rewritten in independent form, and recites, in part, "a sensor array associated with the attachment point and configured to provide signals corresponding to an orientation of the tool." As demonstrated above, Sato's encoders cannot provide signals corresponding to the orientation of its instruction point, but only to its position, and cannot therefore anticipate claim 9.

Claim 12 recites, in part, "a user interface tool configured to be manipulated by the user and moved within a volume of space, and including a sensor array configured to detect rotation of the user interface tool around an axis." Sato fails to teach a sensor array configured to detect rotation of the user interface tool, but instead provides only for determination of the position in space of the instruction point, and is silent with regard to rotation. Thus, Sato so fails to anticipate claim 12.

Kim fails to teach a user interface tool *including a sensor array*, as recited in claim 12. Instead, Kim provides a number of remotely located encoders to track position and orientation of its device by measuring changes in string length. None of those encoders is included as part of an interface tool configured to be manipulated by the user. Accordingly, claim 12 is allowable over Kim.

In rejecting claims 2, 15, and 34-37, the Office Action cites a combination of Kim and Lefkowitz. Applicants respectfully traverse the appropriateness of a combination of Lefkowitz with Kim. The Examiner has not demonstrated that one of ordinary skill in the art in the field of haptics would be expected to have a working knowledge of the field to which Lefkowitz is directed. Kim is directed to a haptic system configured to track a user's direct manipulation of an object while interacting within a virtual environment generated by a computer and represented on a video screen, and provide tactile feedback to the user on the basis of that virtual interaction. For its part, Lefkowitz is directed to a system for positioning a worker or tool well above or below ground level, such as within a nuclear power plant, and has application in industrial processes related to storage tanks, shipyards, dams and bridges,

skyscrapers, hangars, silos, and other structures that have tall vertical surfaces that may require cleaning, painting, maintenance, etc (*Lefkowitz*, 1:10-55). Lefkowitz does not address aspects that are of concern to Kim, such as reflecting force in 6 degrees of freedom, or providing a 3d graphical user interface device that does not require a high degree of training (*Kim*, page 1245, first column). Because one of ordinary skill in the art would not be concerned with the field to which Lefkowitz is directed, and because of their separate classification, such a combination is inappropriate, and claims 2, 15, and 34-37 are allowable thereover.

Claim 38 recites, in part, "deriving a change of position of the tool on the basis of the measured length at each of the vertices of the tetrahedron." Kim fails to anticipate this limitation of claim 38. The Office Action cites the equations on page 1246 as usable for showing a position of Kim's cross. However, Kim employs eight strings coupled at one end to a respective one of the eight corners of a cube, with encoders to determine position and orientation, and the equations provided employ data from all of the eight encoders to determine position. A tetrahedron has only four vertices; none of the equations presented can be used to determine the position of the cross on the basis of four measured values, as would be necessary to anticipate claim 38. Clearly, Claim 38 is allowable over Kim.

Nor could Sato be combined with Kim for the purpose of rejection claim 38, because Sato's equations require that each of the lines be connected to a common point, i.e., the instruction point, while Kim's strings are distributed among the arms of the cross. Thus, a combination of translation and rotation would be incompatible with Sato's equations because they do not account for relative movement among the ends of the lines at the instructions point.

Overall, the cited references do not singly, or in any motivated combination, teach or suggest the claimed features of the embodiments recited in independent claims 1, 9, 12, 18, 29, 34, or 38, and thus such claims are allowable, together with their respective dependent claims. While many of the dependent claims have been shown to be separately allowable, Applicant's decision not to argue the allowability of each of the dependent claims is not to be construed as an admission that those claim not argued separately would not be allowable but for their dependence on allowable base claims, and applicant reserve the right to present such arguments as may become necessary in the future. If the undersigned representative has

overlooked a relevant teaching in any of the references, the Examiner is requested to point out specifically where such teaching may be found.

In light of the above amendments and remarks, Applicant respectfully submits that all pending claims are allowable, and therefore respectfully requests that the Examiner reconsider this application and timely allow all pending claims. The Examiner is encouraged to contact Mr. Bennett by telephone at (206) 694-4848 to discuss the above and any other distinctions between the claims and the applied references, if desired. If the Examiner notes any informalities in the claims, he is encouraged to contact Mr. Bennett by telephone to expeditiously correct such informalities.

The Director is authorized to charge any additional fees due by way of this Amendment, or credit any overpayment, to our Deposit Account No. 19-1090.

Respectfully submitted,

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